By Tori Tragis

The power company in Tanana, a remote village of 230 people on the Yukon River, charged 76 cents per kilowatt hour for residential electricity in 2013, a pre-subsidy rate almost four times the price in Fairbanks. One reason: Tanana generated all its power with diesel barged up the river. Used differently, though, the Yukon River and others could become a path to cheaper power.

Rivers, said Jeremy Kasper '10, are pretty much wherever people live, they're reliable and they're free. As in cheap. Of course, free-running is also on point, because a freely running river can produce electricity without the financial, social and environmental costs of a dam.

Kasper directs the Alaska Hydrokinetic Energy Research Center, which is part of UAF's Alaska Center for Energy and Power. Hydrokinetic energy comes from river or ocean currents, rather than the flow from a dam's reservoir. Because a river's current is generally predictable and reliable — as opposed to the vagaries of wind, for example — it can be a primary source of electricity, and a renewable one at that.

"You want to put the renewable resource in," said Kasper, and not use the generator at all — a process called dieseling off. "Idling hurts efficiency. Wind is hard. Rivers are persistent."

The potential for river turbines in Alaska is huge — some 250 communities not connected to a regional electrical grid are near large rivers. It is also admittedly limited — Kasper said they can be used only about five months out of the year in much of Alaska, when the waters aren't frozen. But that's five months when villages aren't paying for diesel, and five months when carbon isn't spewing into the air.

For the last three years, Kasper and his colleagues at the energy research center have been working with private industry and government agencies to test an in-river turbine as a possible alternative to diesel generators.

It hasn't been easy.

The center was first contacted by Alaska Power and Telephone, a privately owned utility working in 23 communities across the state, about a turbine test in the Yukon River near Eagle. The Denali Commission had funded AP&T to demonstrate the viability of hydrokinetic energy in Alaska. In 2010 AP&T and its partners anchored a turbine on a barge offshore of the City of Eagle,

rent opportunities

The Yukon River, shown here where it flows past Eagle, is one of the Alaska rivers that have been studied for their potential as a renewable energy resource.

where it nicely powered the upstream Eagle Village for about two weeks. Then debris in the massive river's silty water damaged the turbine, and the renewable energy run was over. AP&T turned to the Alaska Center for Energy and Power for help. The center's engineers realized that, before they could take advantage of the river's current, they needed to take care of the river's floating saboteurs, like tree branches, even entire tree trunks. They needed a debris diverter.

And they got one. Picture a barge sitting well off the riverbank, its bow facing upstream. Attached to the taut line anchoring the barge to the river bottom is a large buoy. The buoy helps keep the bow from being held too low in the river by the anchor on the riverbed. The buoy also swivels, acting as a first line of defense against flotsam coming downstream. Two arms attached at angles to the buoy force other debris harmlessly away from the barge.

Jack Schmid, a research professional with the Alaska Center for Energy and Power, enters data at a recording station on the bank of the Tanana River near Nenana.

The turbine itself sits more or less in the middle of the barge, which has a rectangular opening through which the turbine is lowered until its blades spin from the force of the river.

That kinetic energy can be turned into power, but first it has to get from the turbine itself to a power grid. For small-scale projects, such as a village in Alaska, the grid doesn't have to be big. It can be micro, but you still have to get the power there.

"That's where everyone screws up," said Gwen Holdmann, ACEP's director. "They underestimate what it takes — that you just generate power and you're home free." She said that, too often, alternative-energy developers forget to look at a situation holistically — what the climate of a particular area is like, its seasonal variations, its hazards.

Most of Alaska, for example, has winters that freeze even its largest rivers, so hydrokinetics can't be used year-round. Alaska's rivers also have a lot of debris.

Chile's rivers, on the other hand, don't freeze and they have less floating muck.

Chile is a long way from Alaska geographically, but it's on the same mental map for Dan Power. He's the president of Oceana Power Co. and one of the key players bringing together experts and funding sources to make in-river turbines an affordable energy option for rural communities around the world. Power would like to explore Chile's potential, but there are no labs in the country where he could test his company's turbine. Even within the United States, he said, he couldn't find the right combination of facilities and knowledge. Then one of his engineers, who had spent his boyhood summers in Alaska and maintained ties with the state, told him he should see if the Alaska Center for Energy and Power could help him.

It could.

"There's no one else who has the talent and expertise," Power said.

Power is a garrulous Tennessean with a knack for telling a good story (or several). He is also a businessman with a product he wants to move to market, but decades of working in Washington, D.C., in various capacities have taught him that sometimes progress comes slowly, methodically and purposefully. He's willing to wait.

There's more to testing a turbine than just the turbine. There was the debris diverter. Then there's a

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fisheries study, conducted in part by undergraduate and graduate students.

The students looked at the number of young salmon traveling in the same corridor where the barge-based turbine was placed near Eagle, and more recently in the Tanana River, to see if that vitally important fish could be harmed by the system. (The results are still being analyzed and are not yet available.) Then there was a snag — literally — that prematurely ended the 2012 season and that

forced staff to spend the 2013 summer season refining the debris diverter.

By September 2014 the diverter was ready, and Oceana wanted to test their turbine in Alaska's waters in the Tanana River near the small city of Nenana. ATCO trailer units, purchased from and set up by a local contractor, served as offices; a small generator hummed continuously in the background. A Nenana-based barge service had maneuvered the test barge into place several hundred feet offshore. Some half-dozen men, dressed warmly against the chill river wind and with life jackets snug around their torsos, milled about the barge. Some were Oceana staff, there to deploy the turbine. Others were from ACEP, making sure the debris diverter system was working well. For all Power's excitement that his turbine was finally going to be deployed, he ruefully acknowledged the aspect of hurry-up-and-wait.

"Science," he said, "sometimes just looks like a lot of standing around."

Power wants his company eventually to use lightweight, composite materials to make even smaller, more affordable devices for rural communities worldwide. Even a one-cabin homestead could potentially get its electricity from river currents. There are other possibilities, too: The Navy SEALS have said they want something to support communications in the field.

Staff test the efficacy of the debris diverter by tossing branches into the Tanana River in August 2012.

For now, Power and ACEP are still conducting the research and verifying the data. They need to figure out how to relay energy from the turbine to different kinds of grids and whether there's a way to store excess energy. Each system's set-up will differ slightly, depending on the type of renewable energy used, the amount of power generated, the kind of grid employed and the availability of an excess storage facility. But ACEP's director, Holdmann, has another renewable resource at her disposal: location and expertise.

Jack Schmid and Paul Duvoy, research staff with the Alaska Center for Energy and Power, monitor the testing of the in-river turbine in the Tanana River in September 2014.

"Alaska has 12 percent of the world's microgrids powered by renewable resources," Holdmann said. Researchers at the Alaska Center for Energy and Power have conducted work or consulted on a number of the systems throughout the state. She stressed that the center is energy agnostic — that it doesn't rank one energy source over another. Instead, she said, they work with companies and communities to find solutions that meet specific local or regional needs.

Alaska has 12 percent of the world's microgrids integrated with a renewable resource.

Holdmann is optimistic about someday meeting the needs of villages beholden to barges and imported diesel when there's a free river floating right by them. "It's a completely solvable thing."

Tori Tragis is a writer and editor for UAF Marketing and Communications. She likes writing any story that lets her take a field trip. This one took her to Nenana, and she is now lobbying for a follow-up field trip to see the river turbine in Chile.

Web extra: Watch the turbine go into the water and learn more about the Alaska Center for Energy and Power at **www.uaf.edu/aurora/**.